APPENDIX 10B

2002 Marine Archaeological Investigation Report
Prepared under

Agreement No. CE 32/99

Comprehensive Feasibility Study For The

Revised Scheme Of South East Kowloon Development

March 2002

1 SUMMARY

In August 2000, a Baseline Review was completed for the revised scheme of South East Kowloon Development project. The study concluded that there was high archaeological potential for the seabed which will be affected by the proposed scheme. In October 2001, the Institute of Geophysical and Geochemical Exploration carried out a geophysical survey within the study area. This report presents the results of the survey. The methodology is in accordance with Antiquities and Monuments Office (AMO) Guidelines.

The geophysical survey revealed that there are seventeen unidentified targets in Area A, none in Area B and seven in Area C. These comprise both isolated features and clusters of smaller targets. It is not possible to assess their archaeological potential until a diver inspection of them is completed.

The survey also revealed that the seabed within the survey has a large volume of dumped material. It has also been disturbed by trawling and anchoring. The combination of these activities will have significantly reduced the archaeological potential of the study area. However, it is possible that archaeological resources could remain on the seabed.

It is recommended that a diver inspection of the twenty-four unidentified targets is carried out to assess their archaeological potential.

2 INTRODUCTION

In August 2000, a Baseline Review was completed for the revised scheme of South East Kowloon Development Project. The study concluded that there was high archaeological potential for the seabed which will be affected by the proposed development. As the next phase of investigation, in October 2001, the Institute of Geophysical and Geochemical Exploration carried out a geophysical survey within the study area. The raw data set was made available to SDA Marine for interpretation. This report presents the results of the geophysical survey.

3 METHODOLOGY

The study was undertaken using standard MAI techniques described below which follow the Guidelines issued by the Antiquities and Monuments Office (AMO).

3.1 Geophysical Survey Data

Geophysical survey is a standard and internationally accepted method for marine archaeological prospection (United States Department of the Interior, Minerals Management Service, 1991). It provides a fast and reliable method of assessing the seabed and sub-surface sediments for archaeological material. Combined with accurate position fixing, geophysical surveying facilitates detailed mapping of submerged cultural resources.

The Institute of Geophysical and Geochemical Exploration, MLR, PRC carried out a marine geophysical survey of the study areas between October 20th to November 8th (Contract No. GE/2001/20).

The raw data set was re-examined by SDA Marine Ltd.

The archaeological objectives of examining the data were:

- To map shipwrecks and anomalous seabed features
- To determine the underlying significant geological horizons to assess the preservation potential of the seabed sediments

3.2 Study Area

The study area is located in South East Kowloon and includes 3 sub-areas as shown on Chart Figure 3-2.

3.3 Survey Scope

The following geophysical data was collected:

- Side Scan Sonar
- Seismic Reflection
- Echo Sounding
- Marine Magnetic

3.4 Equipment

Below is a summary of the equipment relevant to the archaeological assessment.

- DF3200MK II Echo Sounder

- Valeport VLR740 Automatic Tide Logger
- NT-300D DGPS Differential Signal Receiver
- Season TRACKER Navigation System
- DELPH Seismic Single-Channel Seismic Reflection System
- EPC HSP –1086 Thermal Printer
- Geometric G-880 marine magnetometer
- Edge Tech 560A Side Scan Sonar
- Bar check plate
- HC95 Helium optical pumping marine magnetometer

3.5 Horizontal Location Control

The survey vessel was located by a Differential Global Positioning System (DGPS) using differential corrections broadcast from the Hong Kong beacon differential station.

3.6 Computerised Navigation System

The computerised navigation system TRACKER was added to the Trimble DGPS NT-300D to control the steering of the boat along the traverses specified, and to log all horizontal and vertical control data. This system provides the users with a dynamic screen display on which the following navigation parameters are continuously recorded and updated:

- Layout of traverses specified
- Date and Time
- The quality of the differential signal
- Positioning status
- The number of satellites used in position calculation

Other information displayed for the assistance of the hydrographic surveyor includes, course, speed, fixing status and co-ordinates on the Hong Kong Metric Grid.

3.7 Calibration, Accuracy and Quality Assurance

The Trimble NT-300D receiver was checked at a fixed place near the survey area A at the beginning and end of the survey.

An accuracy of better than ± 2m was ensured by carrying out the above quality assurance checking procedure at the beginning and end of the survey.

3.8 Tidal Data

The tidal data collected by the Hong Kong Observatory at Quarry Bay Tide Station was used to correct the echo sounding data.

3.9 Survey Coverage

Survey lines were completed as shown on the track plots which are presented on Chart Figure 3-1.

3.10 Echo Sounding

The Dual-Frequency Echo sounder Echo Track DF3200 was used in the surveys. It has an accuracy of ± 1% of the water depth. The echo sounder was calibrated using the 'bar check' method, at the beginning and end of each survey. The bar check calibration was done at 2m and 4m respectively. The depth deviation for both high frequency and low frequency is within 1cm.

3.11 Recording Parameters for the Echo Sounding Survey

Vessel Speed: 3-5 Knots

Transducer installation: Broadside

DGPS sampling rate: 1/s

Working Frequency: 30kHz and 200kHz

Echo sounder fixed interval: 250ms

Layback: 0ms

Source Velocity: 1530m/s

Transducer draft: 1.09m

3.12 Recording Parameters for the Seismic Reflection Survey

Vessel Speed: 3-5 Knots

Fix Interval: 10s

Boomer Sources: 140J

Sampling Frequency: 10000Hz

Excited Interval: 500ms

Record Length: 100ms

Filter: 240-800Hz

3.13 Recording Parameters for the Side Scan Sonar Survey

Ves The Edge Tech 560A side scan sonar system with a range of 50m was used for the survey.

Vessel Speed: 3-5 knots

Fix Interval: 30 seconds

Layback: 1m

Source Frequency: 100/500kHz

3.14 Recording Parameters for the Magnetic Survey

The Hc95 Helium Optical pumping magnetometer was used for diurnal variation observation. The magnetic diurnal station was set up at Jardine's Lookout, close to Mount Butler Road. The average value of 447960nT (recorded on 02 November 2001) was adopted to get the diurnal variation.

Geometric G-880 marine magnetometer was used for the survey. The sensor of the marine magnetometer was towed away from the stern of the survey vessel. The distance from the sensor to the GPS annenta was 23.8m for the small boat and 43.8m for the larger boat.

Two lines of cross-line survey were completed along direction S-N and E-W respectively in the survey area which formed four cross-points.

Sampling range was 1 reading per second for the Marine Magnetometer and 1 reading per 4 seconds for the Base Station Magnetometer.

3.15 Site Safety

Site safety was in accordance with the Marine Geophysical Operations Safety Manual, 1996.

4 RESULTS

4.1 Echo Sounding

The echo sounding data was checked, edited and reduced to levels below Principal Datum using the data collected from Quarry Bay tide station set up by the Hong Kong Observatory. The contoured sounding plan was mapped using Surfer software.

In the northern part of Area A, the depth varies between –2.5m PD – 6.5m PD along the channel and –3m PD in the southeast part of the area. The majority of Area B is between -11m –13m PD. Nearly the easterly shoreline it rises steeply to between -4.6m – 8.3m PD. In Area C the depths range between -3 – 9m PD.

4.2 Interpretation of Side Scan Sonar Records

Processing was carried out as follows:

- The marked features in the side scan sonar data were interpreted and marked on the original records.
- The marked features were digitized and plotted.
- The plotted seabed features were checked by reconciling them with the original raw side scan records, and making final adjustments accordingly.
- The features were digitized into Surfer drawings.

The side scan sonar records collected over this area are characterised by the following features:

- 66 Abnormal Features
- Scattered dumped materials
- Dense Trawl marks
- Anchor Scars
- 250m x 30m long Linear anomaly heading Southwest to Northeast in Area A

All of the features listed above are drawn onto the Seabed Features Charts (Chart Figure 3-2).

There is an unusually high volume of material with anthropogenic origin on the Hong Kong seabed. Classification of seabed features is based upon previous experience of identifying such materials. For numerous other MAI projects in Hong Kong, detailed diver inspections of the seabed have been undertaken. This has resulted in an accumulated experience of correlating the ‘acoustic signature’ and the physical manifestation of dumped material.

Theoretically, any anomaly on the seabed could have archaeological potential until it has been 'ground truthed' i.e. inspected by a diver. However, the distinctive acoustic profile of dumped material and debris makes it possible to exclude the possibility that it may have archaeological potential and thus not require diver inspection. Dumped material usually consists of debris, which may originate from coastline construction sites and fishing activities. The debris may comprise the following:

- Decomposed and partially decomposed rock
- Alluvium
- Concrete, much of which may be reinforced
- Machinery of any kind
- Wires and nets

The entire raw data set was examined by SDA Marine Ltd. A total of twenty-four targets with archaeological potential were revealed, the details of which are presented in the table below. Copies of the data showing each target are presented as Figures 1-8.

TABLE OF SIDE SCAN SONAR TARGETS WITH ARCHAEOLOGICAL POTENTIAL

TARGET NO.	STUDY AREA	LENGTH	WIDTH	LOCATION (WGS 84) If only one co-ordinate is given it represents the centre of a cluster	
S1	A	4.36m	2.12m	114°13.08'E	22°18.118'N
S2	A	6.79m	7.45m	114°13.04'E	22°18.180'N
S3	A	7.69m	4.96m	114°13.067'E	22°18.162'N
S4	A	4.37m	2.83m	114°13.092'E	22°18.141'N
S5	A	5.72m	4.37m	114°13.117'E	22°18.118'N
S6	A	4.36m	3.53m	114°13.142'E	22°18.095'N
S7	A	6.99m	3.29m	114°13.165'E	22°18.076'N
S8	A	10.12m	4.02m	114°13.353'E	22°18.118'N
S9 S10 S11 S12	A	3.64m	2.84m	114°13.073'E	22°18.176'N

TABLE OF SIDE SCAN SONAR TARGETS WITH ARCHAEOLOGICAL POTENTIAL					
S13 S14					
S15 S16 S17	A	2.54m	1.54m	114°13.046'E	22°18.194'N
S40 S41	C	24.27m 13.57m	4.57m 2.86m	114°11.931'E	22°18.987'N
S45	C	6.47m	2.81m	114°11.755'E	22°18.859'N
S57	C	3.39m	2.94m	114°11.781'E	22°18.948'N
S58	C	4.36m	3.13	114°11.793'E	22°18.931'N

Chart Figure 3-2 shows sixty six abnormal objects. These were identified by the IGGE during the initial data interpretation. When SDA Marine Ltd examined the raw data the classification was refined and it was concluded that thirty-one of the objects did not represent features with archaeological potential.

4.3 Interpretation of Seismic Profiler Records

Processing was carried out as follows:

- Seismic horizons were selected for interpretation and highlighted on copies of the seismic records during preliminary interpretation.
- All traverse crossing points were then calculated and marked on the seismic records.
- The records were then physically correlated at these points.
- The correlated horizons were digitized, plotted and contoured.

The velocity of the time to depth conversion was defined as 1520m/s in water and 1600m/s in rock.

The data quality was degraded in Area C and it was not possible to analyze the data from the deeper layers.

The seismic records were inspected for artefacts buried in the marine deposits. These show up as "diffraction hyperbolae" which look like mushroom shaped reflectors on the seismic records.

4.4 Seabed Stratigraphy

Geophysical survey data enables (1) establishment of the marine geology and (2) the archaeological preservation potential of the sediments. The survey data will be discussed in terms of its relevance to the marine archaeological investigation; it is not appropriate to provide full geological analysis of the study area.

Based on data from numerous borehole records and seismic surveys of the territory, the Hong Kong Geological Survey has mapped the offshore surficial deposits (e.g. Strange & Shaw, 1986; Langford et al, 1989; Strange et al, 1990). They subdivided the submarine deposits into two formations: the Pleistocene Chek Lap Kok Formations (alluvial/estuarine deposits) and the Holocene Hang Hau Formation (marine muds). Recently, the stratigraphy has been refined with the Sham Wat (~130-85 ky) and Waglan (~85-10 ky) Formations (both shallow marine units) being positioned between the Chek Lap Kok and Hang Hau Formations (Fyfe et al., 1997; 1999).

4.5 The Hang Hau Formation

From an archaeological perspective, the marine sediments assigned to the Hang Hau Formation have the greatest archaeological potential. The formation consists of relatively homogenous very soft to soft, greenish grey silty clay (Fyfe et al., 1997) and has a high moisture content. Therefore, the Hang Hau Formation sediments potentially provide an excellent substrate for the preservation of archaeological material.

Additionally, the soft nature of the sediments would make it possible for archaeological material to be buried within the formation, where it would have greater protection than if it were exposed on the seabed.

Throughout the study area the Hang Hau Formation forms a blanket 3 –13m thick.

4.6 Sham Wat and Chek Lap Kok Formations

The (pre-Holocene) sedimentary formations beneath the Hang Hau Formation in the study area are considered to offer limited to negligible archaeological potential. The original land surface that would have existed at the top of these deposits would have been planed-off during the Holocene marine transgression (Fyfe & Shaw, 1997). Thus, any evidence of late Pleistocene human land activity in the study area would almost certainly have been removed through erosion.

4.7 Interpretation of the Magnetic Survey

Following data processing, the results of the magnetic survey are presented in Chart Figure 4-2. This drawing shows the track plot, observed magnetic data, total magnetic

field after diurnal correction and leveling and magnetic tensor intensity (ΔT). The IGGE defined four different types of anomalies listed below:

- Local weak magnetic anomalies caused by local magnetic objects with small range
- Man made objects identifed by oscillated field
- Linear weak magnetic anomalies interpreted as a pipeline
- High magnetic relief caused by strong magnetic materials on the shore or from anchored or passing vessels

Using the above classification a total of fifteen magnetic objects, two man made objects and 1 pipeline were identified.

5 CONCLUSION

The geophysical survey revealed that there are seventeen unidentified targets in Area A, none in Area B and seven in Area C. These comprise both isolated features and clusters. It is not possible to assess their archaeological potential until a diver inspection of them is completed.

The survey also revealed that the seabed within the survey has a large volume of dumped material. It has also been disturbed by trawling and anchoring. The combination of these activities will have significantly reduced the archaeological potential of the study area. However, it is possible that archaeological resources could remain on the seabed.

6 RECOMMENDATION

It is recommended that a diver inspection of the twenty-four unidentified targets is completed to assess their archaeological potential.

7 REFERENCES

Fyfe, J.A., Selby, I.C., Shaw, R., James, J.W.C. & Evans, C.D.R. 1997. Quaternary sea level change on the continental shelf of Hong Kong. *Journal of the Geological Society of London*, **154**: 1031-1038.

Fyfe, J.A. & Shaw, R. 1997. *The Offshore Geology of Hong Kong*. Hong Kong Geological Survey Memoir. Geotechnical Engineering Office, Hong Kong.

Fyfe, J.A., Selby, I.C., Plater, A.J. & Wright, M.R. 1999. Erosion and sedimentation associated with the last sea level rise offshore Hong Kong, South China Sea. *Quaternary International*, **55**: 93-100.

Strange, P.J., Shaw, R., & Addison, R. 1990. *Geology of Sai Kung and Clear Water Bay*. 1: 20 000 Sheets, 8,12, & 16. Hong Kong Geological Survey Memoir No.**4.** Hong Kong Government Printer.